115 Visual Acuity

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Definition

Central visual acuity refers to the ability of the visual system to discern fine distinctions in the environment as measured with printed or projected visual stimuli. The presence of excellent visual acuity tells the examiner that the ocular media are clear, the image is clearly focused on the retina, the afferent visual pathway is functioning, and the visual cortex has appropriately interpreted signals received. Measurement of visual acuity is a most sensitive test of the integrity of the visual system and fulfills all standard criteria of a good screening test: (1) there is minimal cost or risk to the patient; (2) measurement can be performed quickly and easily with little or no examiner training; (3) there is a high prevalence of detectable abnormalities; and (4) abnormalities are most often amenable to treatment.

Technique

The goal in testing central visual acuity is to determine the best possible visual acuity in each eye. In most instances, either a standard printed Snellen eye chart is used with the patient 20 feet (6 m) away or a reading card with a reduced eye chart is used at 14 inches (35 cm). One eye at a time is tested with the fellow eye occluded. If distance spectacles are used by the patient (i.e., "the glasses you drive and walk around with"), they should be worn during testing. If the reduced visual acuity card is being used at 14 inches, the patient over 40 years of age should wear reading glasses or bifocals ("the glasses you read with"). Should the patient's glasses not be available, an approximation of best corrected visual acuity can be obtained with the use of a pinhole held as close to the eye as possible while testing vision.

Do not waste time and have every patient read every letter of the visual acuity chart. A much easier and faster technique is to instruct the patient to "read the smallest line that you can see." Often, this will result in the patient going right to the 20/20 line and reading it correctly, saving considerable time.

Some patients, particularly the elderly, require encouragement to continue reading smaller letters after initially giving up. "I know the letters are small and blurry, but if you had to guess, what could those letters be?" Such encouragement will often improve the performance of patients on acuity testing.

When testing visual acuity at 20 feet is not possible or practical, the near visual acuity card can be used. With individuals over the age of 40, if reading glasses or bifocal spectacles are used, visual acuity measured with the near card at 14 inches correlates well with distance visual acuity. In those instances when neither distance testing nor a near acuity card is available, an approximation of acuity can be made (e.g., "can read small newspaper print at 2 feet").

When the patient cannot read the largest line of print on an acuity chart at the accustomed distance, he can be slowly moved toward the chart until the largest letter can be read. The numerator of the Snellen fraction becomes the shortened distance (e.g., 10 feet) and the denominator refers to the smallest letter read on the chart (i.e., the 20/400 "E"). If no letters can be read at any distance, the examiner then asks the patient to count fingers at progressively shorter distances until this task can be reliably performed and the distance is recorded (e.g., "counts fingers at 3 feet"). If finger counting is not possible, one checks for the perception of hand motions, then light perception with accurate localization, light perception with localization, and finally, no light perception (Table 115.1).

The visual acuity is recorded using appropriate symbols (Table 115.2) to indicate whether spectacles were used. The numerator is the testing distance and the denominator can be thought of as the maximum distance at which a person with normal visual acuity can read a given line on the eye chart. The line recorded is the last one in which the patient correctly reads the majority of letters (Table 115.3). The visual acuity in the right eye is written above the acuity fraction for the left eye.

For very young, retarded, or illiterate patients, modifications of the basic Snellen acuity chart, using pictures or other symbols, can be useful in assessing visual acuity.

Basic Science

The eye is a complex neurosensory organ that functions to discern patterns and distinctions in light stimuli and, via the optic nerves and tracts, transfer these distinctions to the visual cortex and the interpretive centers of the brain.

Light energy is transformed into neural impulses by retinal photoreceptors, the rods and cones, and within the retina, information processing is begun. Only at the fovea is the density of cones sufficient to allow excellent central visual acuity. Following intraretinal information processing, impulses are transmitted to the ganglion cells, which coalesce to form the optic nerve. Visual information is transferred via the lateral geniculate bodies to the occipital cortex

Table 115.1
Recording Very Poor Visual Acuity

Abbreviation	Meaning
10/400	Can see only 20/400 letter when 10 feet from eye chart
CF @ 6″	Can count fingers only at 6 inches
HM	Hand motions only
LP	Light perception only
NLP	No light perception

Table 115.2
Abbreviations for Visual Acuity Data

Symbol	Meaning
Va	Visual acuity
Va sc	Visual acuity without correction (glasses)
Va cc	Visual acuity with correction (glasses)

Recording the Visual Acuity

20/20		Visual acuity without correction
Va sc	=	in the right eye is 20/20 and in the
20/40		left eye is 20/40

Table 115.3
The Snellen Visual Acuity Fraction

Numerator	=	Distance at which vision is tested.
Denominator	=	Maximum distance at which a line of letters can be seen with normal visual acuity.
Example	:	20/50
Meaning	:	Vision is tested at 20 feet and the smallest letters seen can be read at 50 feet by people with normal visual acuity. (The 50 or 20/50 is usually marked on one side of each line of letters.)

Therefore, if visual acuity fraction <1, acuity is defective!

where patterns may be interpreted and integrated to create a picture of the world.

The primacy of vision among the senses is highlighted by a comparison of neural input from the different sensory organs; the cochlear division of the acoustic nerve contains approximately 31,000 neurons; the optic nerve, about 1,200,000.

The letters on the 20/20 line of an eye chart represent a size of print projecting a retinal image subtending a defined arc when viewed at 20 feet. It follows that the letters of half that size on the same chart, namely the 20/10 letters, could be used to test for "20/20" visual acuity if the same chart had to be viewed at only 10 feet (i.e., 20/20 = 10/10); the visual angle is the same.

In order for central visual acuity to approach the normal range, several conditions must be met. Light rays must be properly refracted by the cornea and crystalline lens to be clearly focused upon a healthy foveal region of the retina and then neurally transmitted to the occipital cortex. The fundamental mechanisms of central visual loss are therefore twofold: (1) The optical properties of the eye are altered to cause loss or distortion of light on its path to the retina; and (2) the retina is diseased or the neural pathways or cortical reception is defective.

A pinhole can be used to minimize incorrect refraction of light resulting in poor visual acuity. A pinhole placed in front of the eye being tested excludes improperly refracted rays of light and permits only central, unrefracted rays of light to reach the macula, thereby minimizing the adverse effect of refractive error on visual acuity testing. Thus, improper refraction, amenable to spectacle correction, can often be implicated or excluded as a cause of poor vision with the use of a pinhole.

Clinical Significance

There are a number of excellent reasons for determining the central visual acuity in each eye when performing any ocular examination.

- *Biological:* Central visual acuity can be thought of as the "vital sign" of ocular function. As stated previously, when the visual acuity is found to be 20/20, a great deal of information is obtained: the eye is properly refracted, the ocular media are clear, the foveal region of the retina is functioning, the optic nerve and visual cortex are generally intact. Taken together with confrontation visual field testing and pupillary function, the measured level of visual acuity can be used to corroborate or question a patient's complaint of decreased visual acuity. The determination with a bright light of no light perception is highly significant and even in the acute setting usually denotes total, irreversible visual loss.
- *Functional:* Visual acuity worse than 20/40 is frequently associated with difficulty in reading small print. State laws differ, but visual acuity of 20/40 to 20/60 or better in at least one eye is generally required for driving an automobile. Visual acuity of 20/200 or worse in the better seeing eye is a frequently used parameter in determining legal blindness. When the ability to count fingers is lost, the patient is no longer able to ambulate efficiently and safely.
- *Legal:* In examining a patient for any ocular complaint, especially in an emergency setting, testing and recording the visual acuity before any ophthalmic examination or treatment are imperative. Visual acuity recorded in this setting can prevent future ambiguity regarding the time and cause of visual loss.

References

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